HOLT CONSULTING ENGINEERS (PTY) LTD

TUMELA 18 TON SKIP DESIGN

H-MAC603

H-MAX603-CAL-MM-18SKIP-001-SHT-001

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REVISION HISTORY

REV	DESCRIPTION	DATE	ISSUED BY	REVIEWED BY	APPROVED

1 CUSTOMER DETAILS

Customer:	Max Power Services (Pty) Ltd
Customer Name:	Herman de Koker
Customer Email:	harry@maxpower.co.za

2 CALCULATION INPUT DATA

2.1 Applicable Design Codes

SANS 10208: 3 - 2017: Design of structures for the mining industry Part 3: Conveyances

SANS 10610: Buildling loading code

SANS 10162: Steel design

2.2 General Data

Design Method	Limit States (Rope Break Conditions)	
Material of Construction	Main Body: EN10025 S355JR	
Material of Construction	Liners: VRN 500	
Yield Stress	355	MPa
Skip Weight	9878	kg
Payload	18000	kg
Winding Speed	15	m/s
Winding Rope Diameter	54	mm
Winding Rope Unit Mass	12.45	kg/m
Rope Break Force	2319	kN
Winder Acceleration	0.8	m/s^2
Winder Trip Acceleration	5	m/s^2
Winder Travel Distance	1023	m
Number of Cycles per Month	3000	
Skip Internal Height	5600	mm
Skip Internal Width	1557	mm
Skip Internal Depth	1400	mm
Skip Overall Height	10713	mm
Skip Overall Width	1856	mm
Skip Overall Depth	1743	mm
Ore Bulk Density	1950	kg/m^3

2.3 Assumption Data

Spacing between rails	1800	mm
Top Hat Guide Specification	340 x 175mm	
Top Hat Guide Material Specification	EN10025 S355JR	
Top Hat Guide Unit Mass	85.95	kg/m
Top Hat Guide Width	175	mm
Bunton Stiffness	1608000	N/m
Guide Stiffnes	1600000	N/m

2.4 Sketches and Drawings

2.4.1 General Arrangement

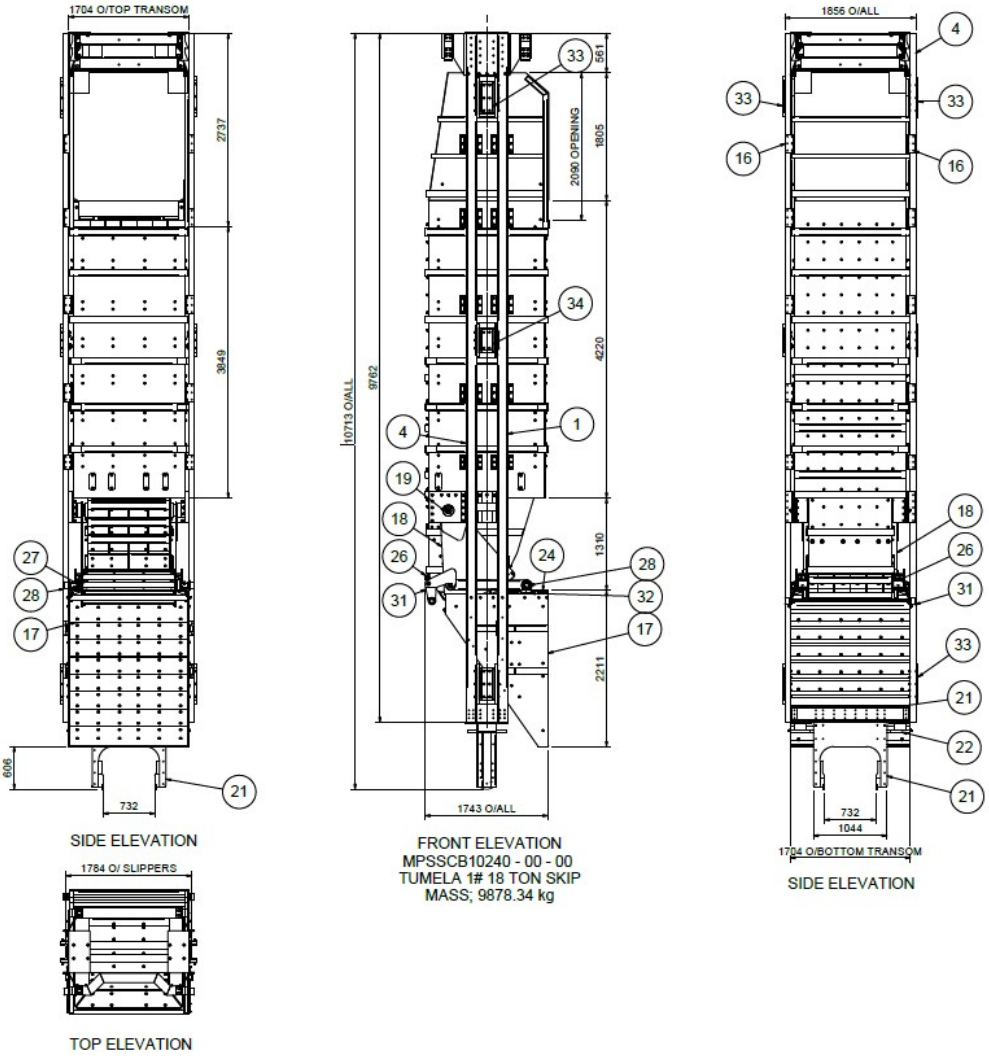
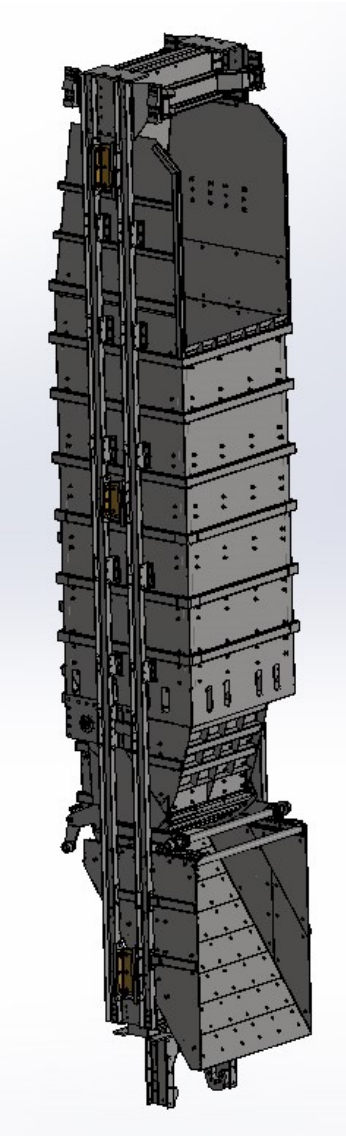
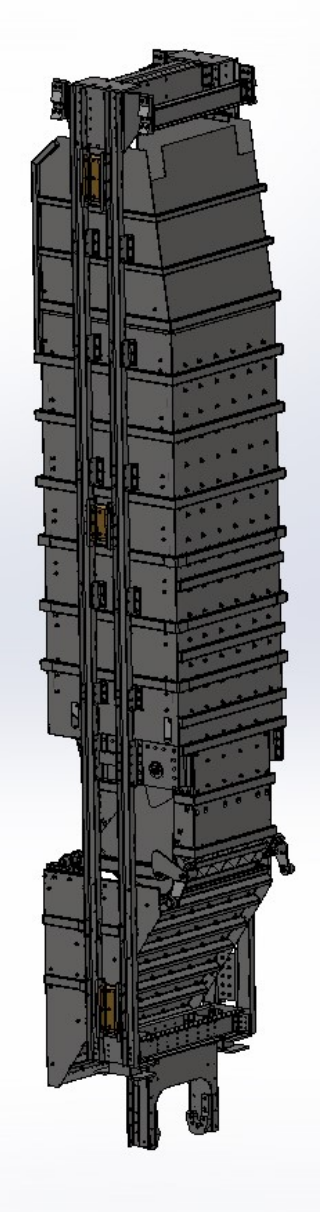


Figure 1: 18 ton Skip Drawing

2.4.2 Isometric Views



(a) 18 ton Skip Isometric View 1



(b) 18 ton Skip Isometric View 3

3 CALCULATIONS

3.1 General Operating Loads - Skip Loads

3.1.1 Permanent Loads

Skip Bridle Sides	m_1	1167	kg
Skip Bridle Top Transom	m_2	1522	kg
Skip Bridle Bottom Transom	m_3	850	kg
Skip Unit	m_4	6336	kg
Permanent Load	$G_c = (m_1 + m_3 + m_4)g$	81943	N

3.1.2 Vertical Imposed Loads due to Holding Devices - Holding Device Engagement Load (K)

Engagement Impact Factor	α_k	1.5	
Personnel Load	P	0	kg
Equipment or Rolling Stock	M	0	kg
Material Static Load	R	18000	kg
Tail Rope Load	T	0	kg
Maximum Applicable Load	C_y	176580.0	N
Holding Device Engagement Load	$K = \alpha_k(G_c + C_y + T)$	387784.5	N

3.1.3 Vertical Imposed Loads due to Holding Devices - Holding Device Security Load (Kc)

Engagement Impact Factor	α_s	2	
Personnel Load	P	0	kg
Equipment or Rolling Stock	M	0	kg
Material Static Load	R	18000	kg
Tail Rope Load	T	0	kg
Maximum Applicable Load	C_y	176580.0	N
Holding Device Engagement Load	$K_c = \alpha_s(G_c + C_y + T)$	517046.0	N

3.1.4 Laterial Imposed Loads (H) - Fixed Guide Systems in Vertical Shafts

Engagement Impact Factor	α_s	2	
Personnel Load	P	0	kg
Equipment or Rolling Stock	M	0	kg
Material Static Load	R	18000	kg
Tail Rope Load	T	0	kg
Maximum Applicable Load	C_y	176580.0	N
Holding Device Engagement Load	$K_c = \alpha_s(G_c + C_y + T)$	517046.0	N

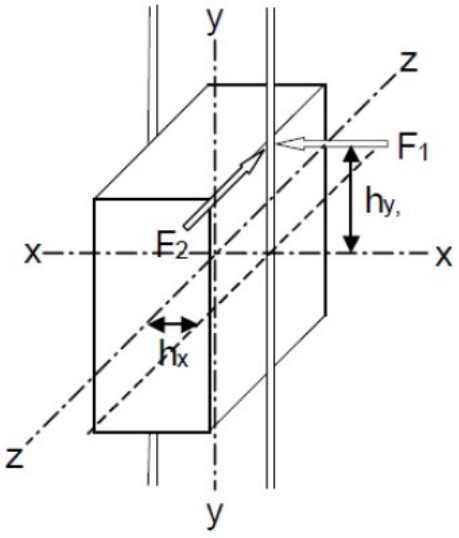


Figure 3: Properties Diagram

Clearance between Roller and Slipper	Δ_c	10	mm
Slipper Plate Impact Factor	α_n	2	
Guide Roller Assembly Stiffness	k_r	500000	N/m
Bunton Stiffness	k_b	1608000	N/m
Guide Stiffnes	k_g	1600000	N/m
Moment of Inertia about X-axis	I_x	80510	$kg.m^2$
Moment of Inertia about Y-axis	I_y	6838	$kg.m^2$
Moment of Inertia about Z-axis	I_z	82050	$kg.m^2$
Distance from slipper to center of gravity	h_x	892	mm
Distance from slipper to center of gravity	h_y	4847	mm
Distance from slipper to center of gravity	h_z	28	mm
Guide Roller Lateral Load	H_f	5000000	N
Steelwork Stiffness Ratio	r_k	1.005	
Weight of Skip System	m_c	8353	kg
Effective Mass About y - x Plane	$m_x = (m_c I_z)/(I_z + m_c(h_y)^2)$	2463.0	kg
Effective Mass About y - z Plane	$m_z = (m_c I_x I_y)/(I_x I_y + (m_c I_x (h_y)^2) + (m_c I_y (h_x)^2)$	280.0	kg
Non-Dimensional Laterial Stiffness	$K_x = (k_b L_b^2)/m_x V^2$	9	
Non-Dimensional Laterial Stiffness	$K_z = (k_b L_b^2)/m_z V^2$	83	
Plate Coefficient from graph	P_b	0.05	
Maximum Moving Misalighnment	e	0.01	m
Lateral Slipper Pad Load	H_s	7791	N

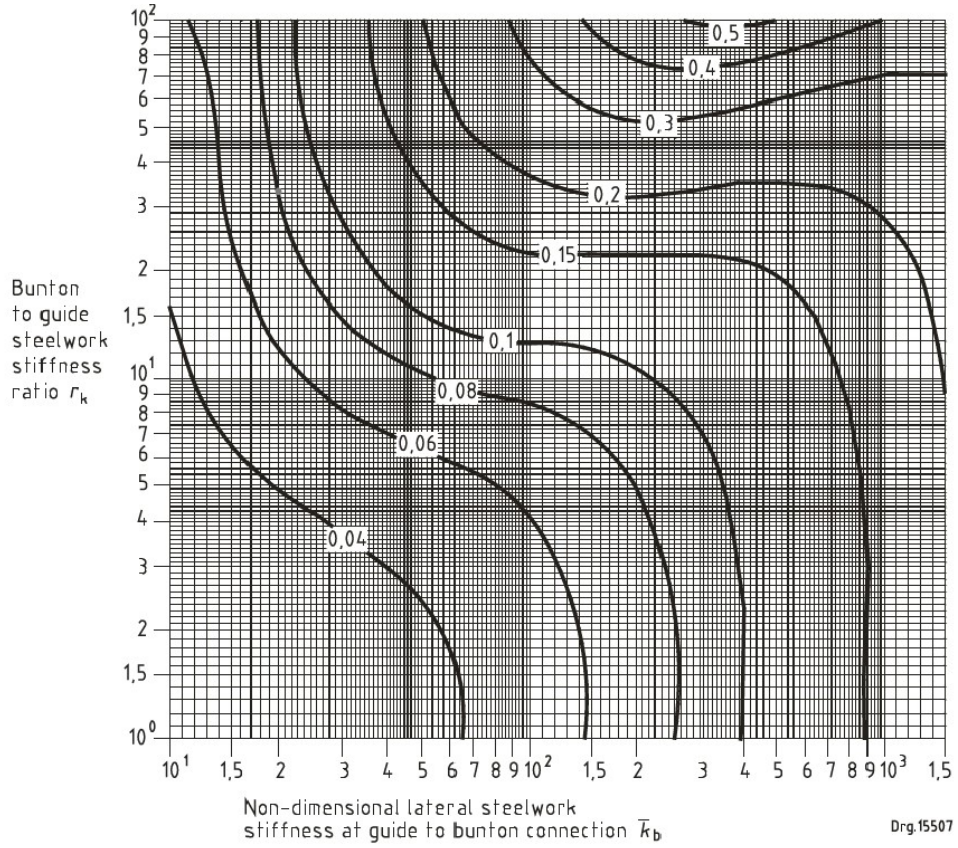


Figure 1 — Contour plot of slipper plate load coefficient $\overline{Pb}$

Figure 4: Slipper Plate Load Coefficient Pb

3.1.5 Winder System Loads

Dynamic Impact Factor	α_d	2	
Winder Acceleration and Deceleration	a_o	0.8	m/s^2
Winder Trip Acceleration	a_t	0.8	m/s^2
Skip Self Weight	G_c	81943	N
Content Load	C_y	176580.0	N
Tail Rope Load	T	0	N
Acceleration Load	$A_o = (\alpha_d)a_o(G_c + C_y + T)/g$	42165	N
Acceleration Trip Out Load	$A_t = (\alpha_d)a_t(G_c + C_y + T)/g$	42165	N

3.1.6 Emergency Loads

Emergency Load	E_r	2319000	N

3.1.7 Vertical Friction Loads

Lateral Slipper Pad Load	H_s	7791	N
Vertical Friction Load	$F_v = 0.5H_s$	3895.5	N

3.2 Skip Loads

3.2.1 Bridle and Transom Loads during Filling (Rd)

Bulk Density of Ore	ρ_b	1950	kg/m^3
Maximum Container Height	z	5600	mm
Rock Pressure	$p_o = \rho_b g z$	107125.2	N/m^2

3.2.2 Gravity Rock Presssure

Filling Impact Factor	α_p	1.5	
Drop Height Estimate for Single Rock	h_d	25	m
Deformation of Skip Door	d_i	87.5	mm
Largest Rock Size Estimate	m_r	1375.0	kg
Skip Bottom Pressure	$p_1 = \alpha_p p_o$	160687.8	N/m^2
Skip Side Pressure	$p_2 = \alpha_p p_o$	160687.8	N/m^2
Impact Energy	$Z_i = 0.5 h_d g m_r$	168609.375	N/m^2
Impact Load	$R_i = Z_i/d_i$	1926.9642857142858	N/m^2

3.2.3 Pressure during Filling or Travelling in Shaft

Tipping Impact Factor	α_t	2	
Tipping Rollers Load	$R_t = \alpha_t 0.25(R + G_c)$	129261.5	N

3.2.4 Tipping Rollers Load

Skip Bridle Sides	m_1	1167	kg
Skip Bridle Top Transom	m_2	1522	kg
Skip Bridle Bottom Transom	m_3	850	kg
Skip Unit	m_4	6336	kg
Permanent Load	$G_c = (m_1 + m_3 + m_4)g$	81943	N

3.2.5 Skip Return-stop Loads

Skip Bridle Sides	m_1	1167	kg
Skip Bridle Top Transom	m_2	1522	kg
Skip Bridle Bottom Transom	m_3	850	kg
Skip Unit	m_4	6336	kg
Permanent Load	$G_c = (m_1 + m_3 + m_4)g$	81943	N

4 SUMMARY

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